

HOW to THINK

ANSWERING QUESTIONS BY

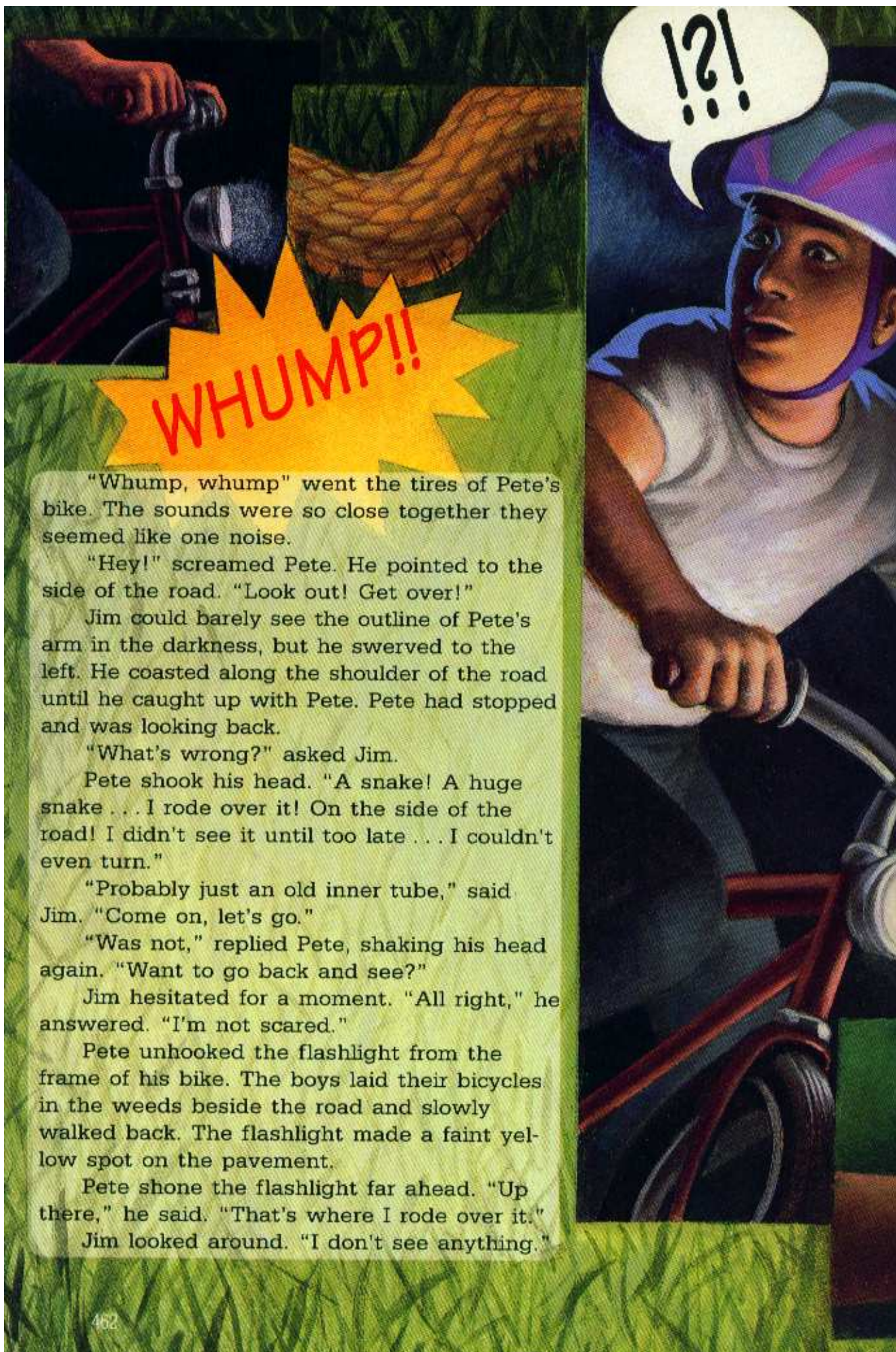


Like a Scientist

THE SCIENTIFIC METHOD

by Stephen P. Kramer
illustrated by Kim Behm





"Whump, whump" went the tires of Pete's bike. The sounds were so close together they seemed like one noise.

"Hey!" screamed Pete. He pointed to the side of the road. "Look out! Get over!"

Jim could barely see the outline of Pete's arm in the darkness, but he swerved to the left. He coasted along the shoulder of the road until he caught up with Pete. Pete had stopped and was looking back.

"What's wrong?" asked Jim.

Pete shook his head. "A snake! A huge snake . . . I rode over it! On the side of the road! I didn't see it until too late . . . I couldn't even turn."

"Probably just an old inner tube," said Jim. "Come on, let's go."

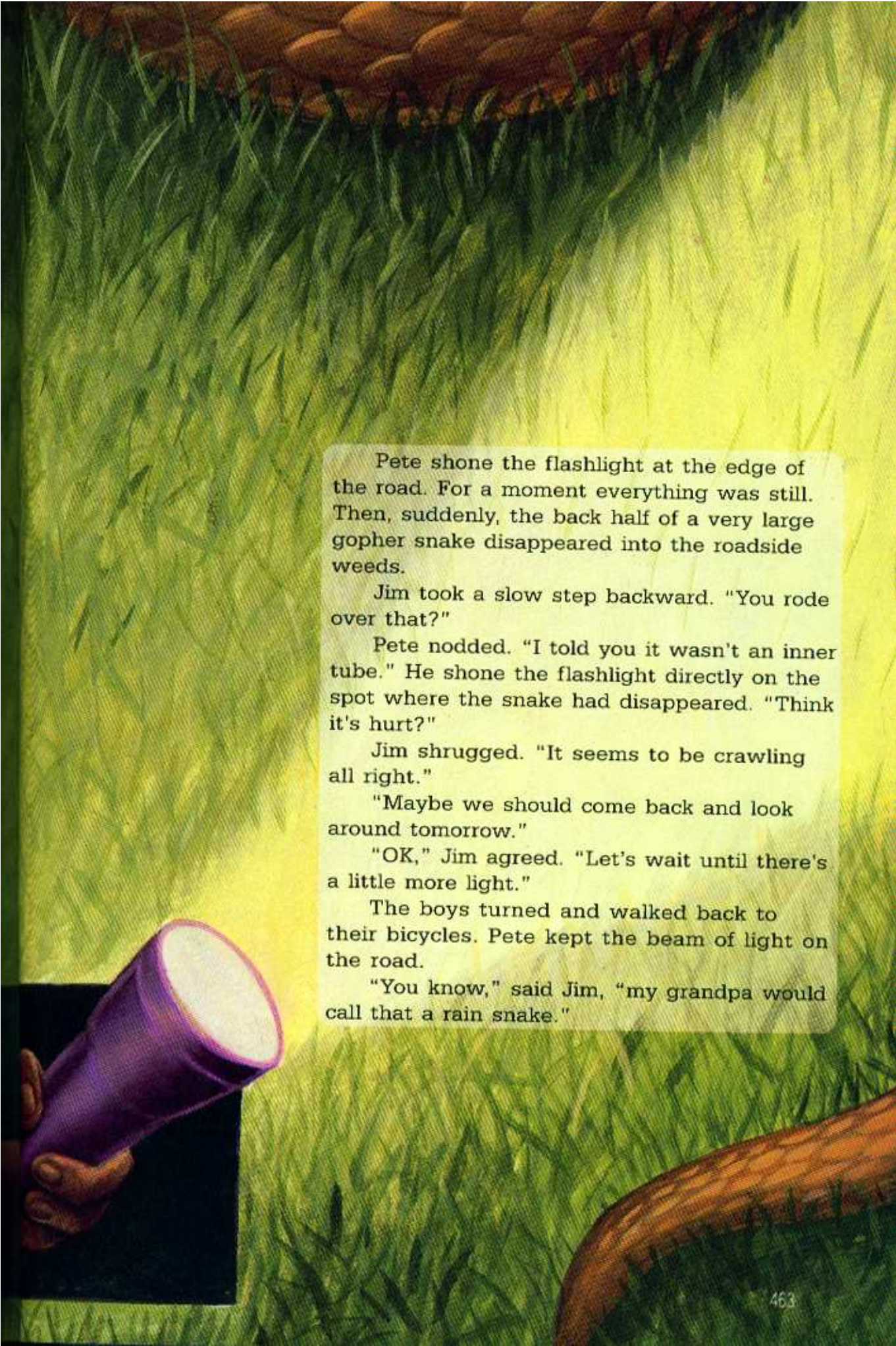
"Was not," replied Pete, shaking his head again. "Want to go back and see?"

Jim hesitated for a moment. "All right," he answered. "I'm not scared."

Pete unhooked the flashlight from the frame of his bike. The boys laid their bicycles in the weeds beside the road and slowly walked back. The flashlight made a faint yellow spot on the pavement.

Pete shone the flashlight far ahead. "Up there," he said. "That's where I rode over it."

Jim looked around. "I don't see anything."



Pete shone the flashlight at the edge of the road. For a moment everything was still. Then, suddenly, the back half of a very large gopher snake disappeared into the roadside weeds.

Jim took a slow step backward. "You rode over that?"

Pete nodded. "I told you it wasn't an inner tube." He shone the flashlight directly on the spot where the snake had disappeared. "Think it's hurt?"

Jim shrugged. "It seems to be crawling all right."

"Maybe we should come back and look around tomorrow."

"OK," Jim agreed. "Let's wait until there's a little more light."

The boys turned and walked back to their bicycles. Pete kept the beam of light on the road.

"You know," said Jim, "my grandpa would call that a rain snake."

"What?" asked Pete.

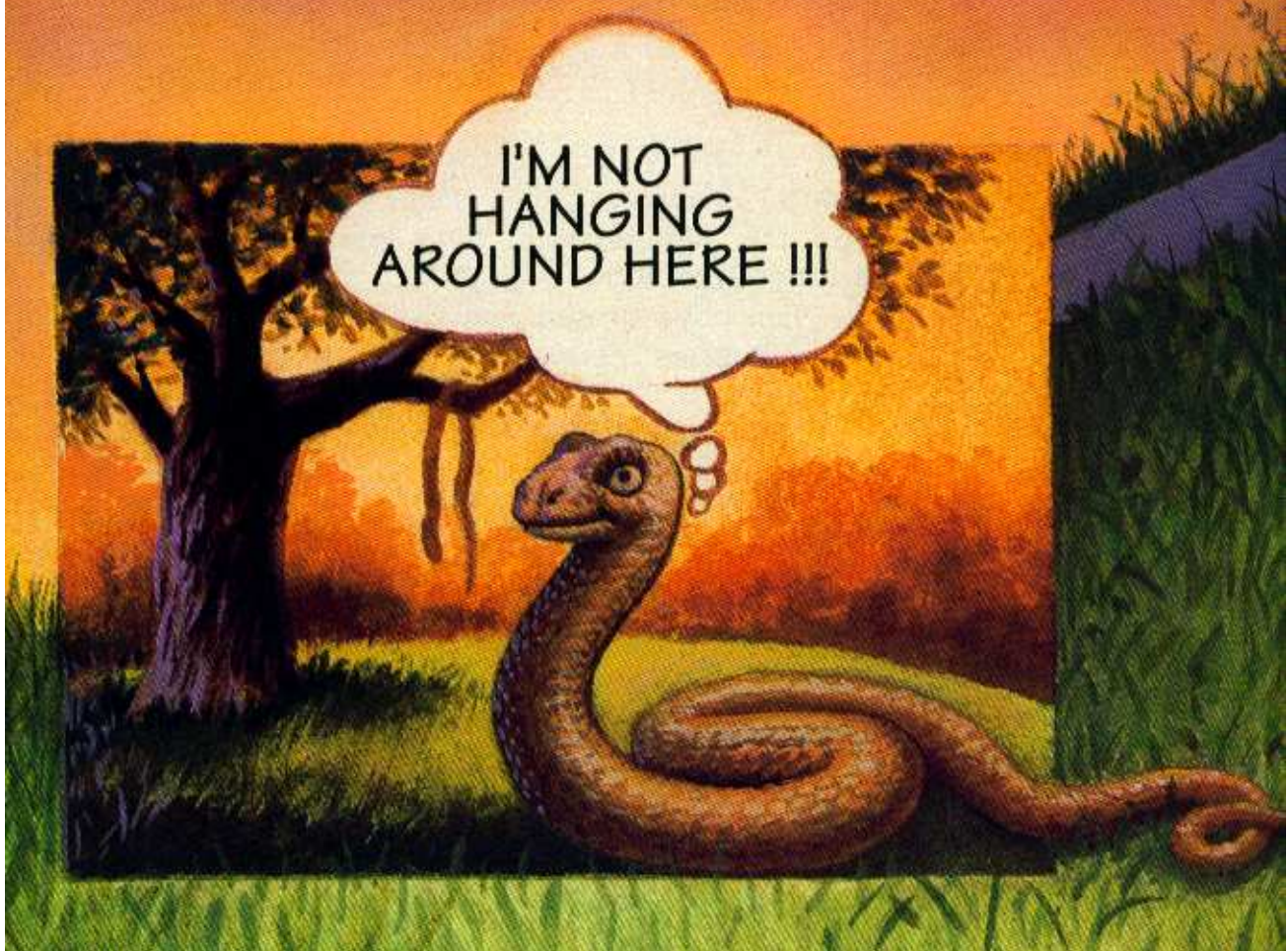
"A rain snake. He'd say you could make it rain for sure with a snake like that."

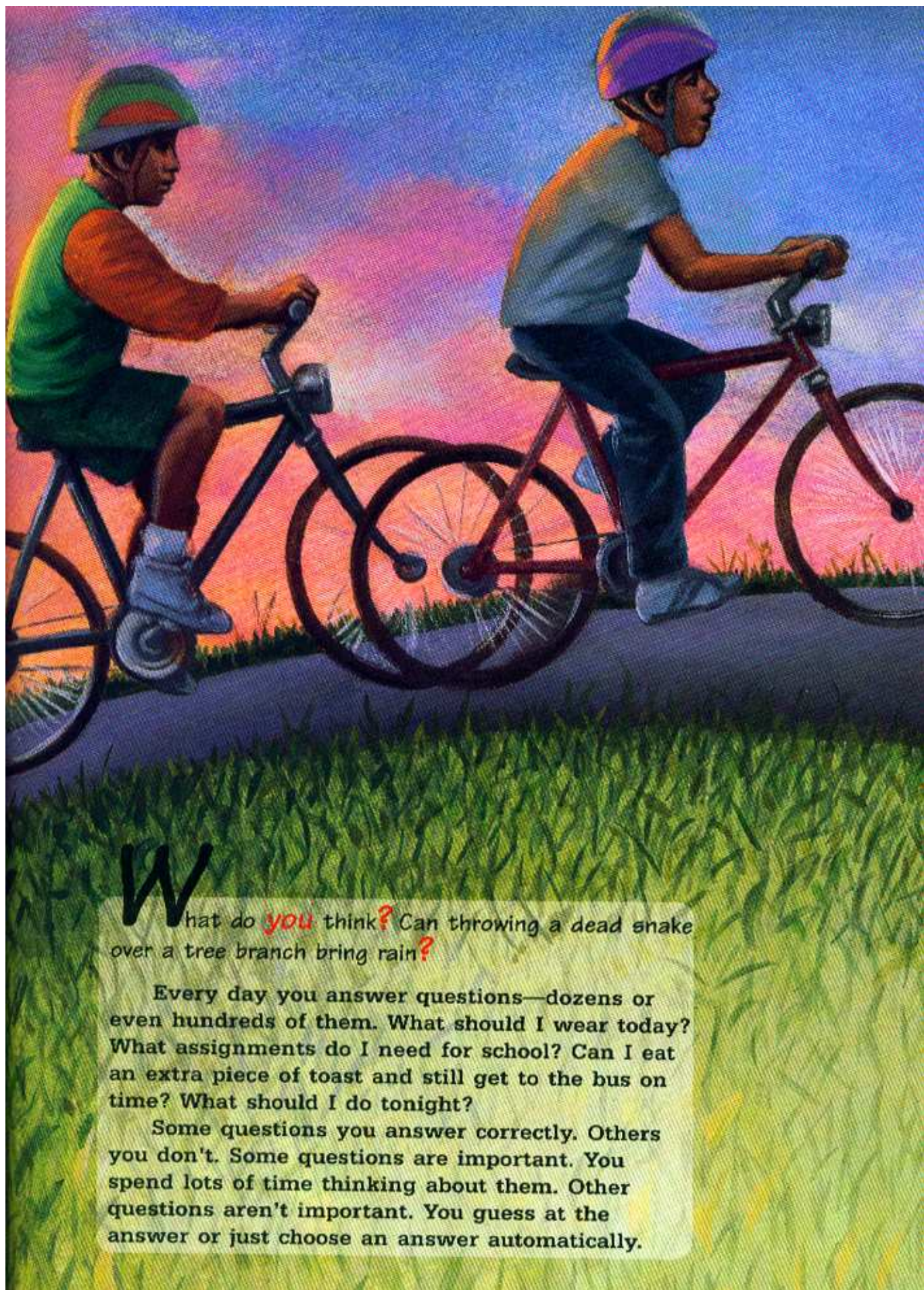
"How?"

"Well," said Jim, "my grandpa grew up way back in the hills. When he was a boy, the farmers would sometimes use a dead snake to make it rain. They'd find a large tree with a strong low branch and throw the snake over the branch. A big snake like that would bring rain for sure."

Pete leaned over and picked up his bike. "You believe that?"

"Naw," answered Jim quickly. Then he scratched his head and looked back down the road. "But, well, I never tried it. I don't know. My grandpa says they did it a lot. Maybe it'd work for some people, sometimes. . . ."





What do **you** think? Can throwing a dead snake over a tree branch bring rain?

Every day you answer questions—dozens or even hundreds of them. What should I wear today? What assignments do I need for school? Can I eat an extra piece of toast and still get to the bus on time? What should I do tonight?

Some questions you answer correctly. Others you don't. Some questions are important. You spend lots of time thinking about them. Other questions aren't important. You guess at the answer or just choose an answer automatically.

How Do **You** Answer Questions?

You think about many things when you try to answer a question. You try to remember things you know that might help you. You look for new information about the question. Sometimes you try to guess how someone else would answer the question. Other times you might pick an answer because of what you would **like** the answer to be.

Sometimes these things help you find a correct answer. Other times they lead you to a wrong answer.

Here are three stories. Each story has a question. Each story tells about something that could happen to you, and each story will show a different way of answering a question.

INFORMATION

You're sitting on your bed one afternoon reading a book about a mountain climber. Things are getting very exciting (an avalanche has just started) when your little brother Ralphie walks into the room. He strolls past your bed and looks out the window.

"Hey," he says, "someone's in Mr. Murphy's backyard."

Your teeth start to grind. You've lost your place but you try not to show it. A long time ago you learned that sometimes the best way to get along with Ralphie is to ignore him.

"Hey," says Ralphie, "they're going into the Murphys' house."

You frown and roll over, wondering when Ralphie is going to go away.

"Hey," says Ralphie, "they're coming out of the Murphys' house. They're carrying something that's all covered up. They're stealing something from the Murphys!"

You sit up straight. The Murphys? Someone is stealing something from the Murphys?



QUESTION: *Is someone stealing something from the Murphys?*

Then, out the window you see a truck. It is parked in front of the Murphys' house. Painted in large blue letters on the side of the truck are the words "Jake's TV Repair."

You shake your head.

"Go on," you tell Ralphie. "Take off."

"They're stealing something from the Murphys' house," says Ralphie. "The bad man just went back inside."

"It's not a bad man," you explain. "Someone's just picking up the TV. Can't you see that truck out there?"

"They're not taking the TV," Ralphie insists.

"Get out!" you shout.

"No!" says Ralphie.

"I said get out!" you scream, throwing a pillow at Ralphie.

So Ralphie finally leaves, walking out of the room very slowly.





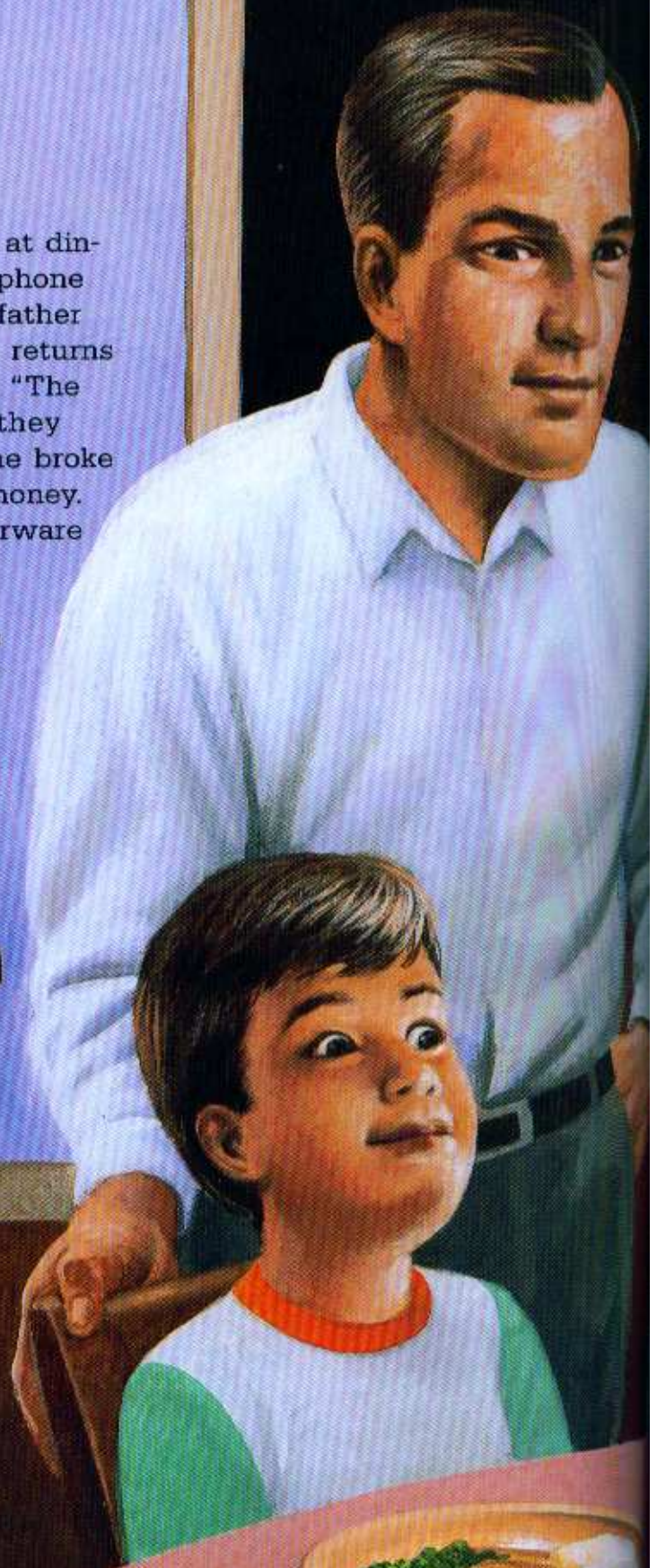
RRRING!

That night at dinner the telephone rings. Your father answers it. When he returns to the table, he says, "The

Murphys just got home. While they were gone this afternoon, someone broke into their house and stole some money. The burglars also took some silverware and Mr. Murphy's violin.

"Most of our neighbors were gone this afternoon. The Johnsons didn't see anything because they were watching a repairman fix their TV all afternoon. Did any of you see anything?"

Ralphie sits up straight and begins nodding.



What happened? The question was: **Is** someone stealing something from the Murphys? You and Ralphie both made observations. Ralphie's observations told him the answer was **yes**. Your observations told you the answer was **no**. Why did you and Ralphie end up with different answers to the same question?

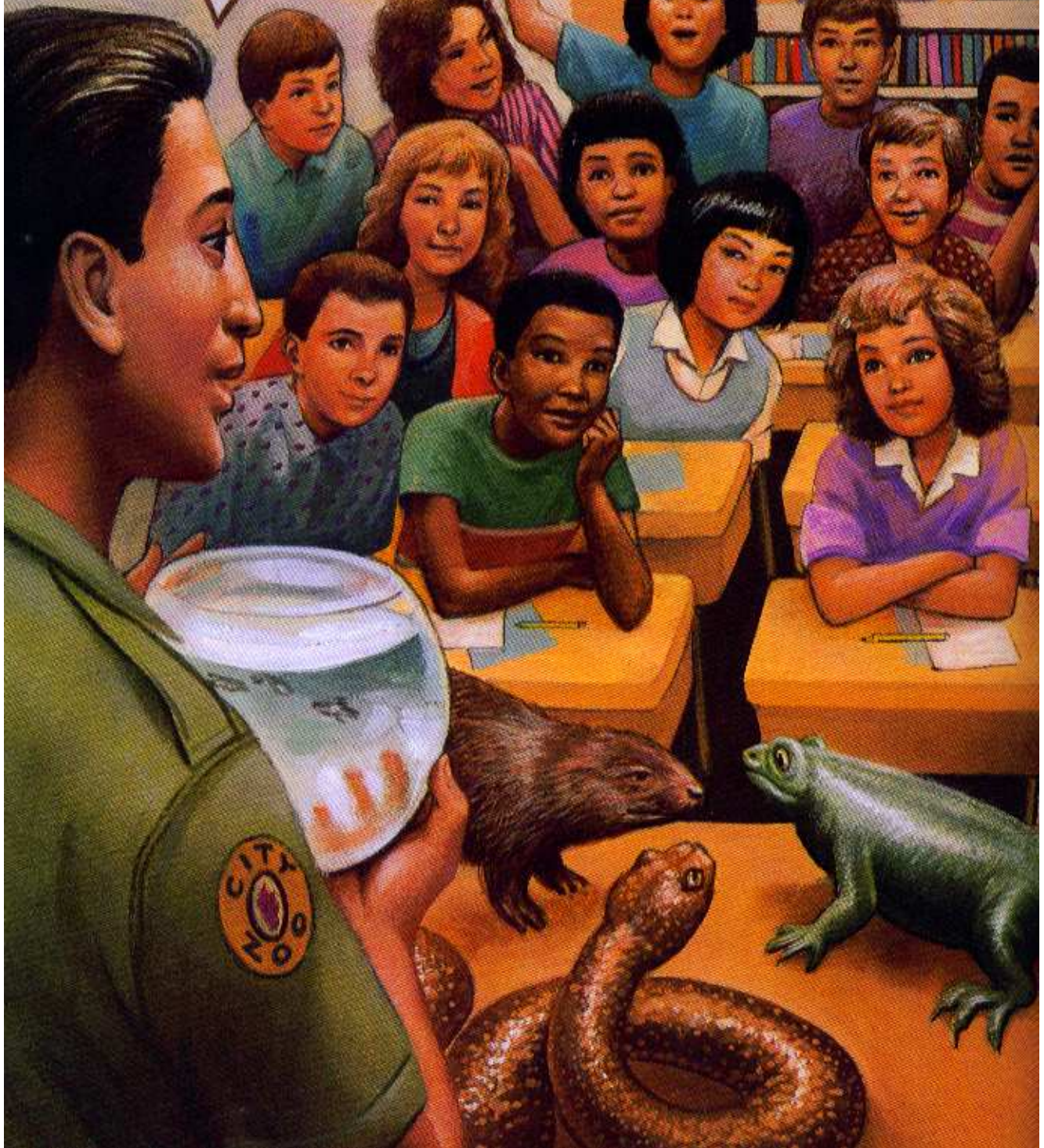
You answered the question incorrectly because of the way you used an observation. You saw a TV repair truck through the front window. Your observation was a good one. You noticed what kind of truck was on your street and where it was parked. The problem was how you used your observation. You thought the truck was giving you information about who was in the Murphys' house. Actually, Ralphie was giving you better information.

Information must be used carefully. Having information does not always mean you will answer a question correctly. If the information is not true or is not used in the right way, it can lead to a wrong answer.



WHO KNOWS
THE NAMES OF
THESE FISH?

What Other People Say
Sometimes we answer ques-
tions in a certain way because
of what other people think or
say. Here's another story.



It's Wednesday morning, just before lunch. Your teacher arranged for someone from the zoo to come and show your class some animals. You have seen an iguana, a mongoose, and a large snake. Now the zookeeper reaches into a wooden box and pulls out a fishbowl. He sets the bowl on a low table at the front of the room. Three small gray fish swim back and forth.

"Who knows the name of these fish?" asks the zookeeper.

Everyone is quiet. You stare at the fish for a moment. Of course you know what they are. They're guppies! They look just like the fish in your sister's aquarium. You've spent hours watching guppies.

Quickly, you raise your hand, but you're sitting in the last row and the zookeeper doesn't see you.

You wave your hand back and forth. The girl next to you ducks.

"These are gastromorphs," says the zookeeper. "They live in slow, muddy streams in Africa. They are very dangerous. They will eat almost anything that moves."

Quickly, you pull your hand down and look around. "Whew," you think. "That could have been embarrassing." Then you lean forward and squint at those fish again.

"We always keep a strong screen over this fishbowl when we visit schools. If anyone were to stick a hand in the water, well, these little fish would immediately attack and begin taking bites out of it."



QUESTION: What kind of fish is in the bowl?

This time the question seems easy. The fish look a lot like guppies. They swim like guppies. They're even the size and color of guppies. But would you stick your hand in the bowl? Of course not! The zookeeper just told you they are gastromorphs. Zookeepers know their animals, right? So the fish must be gastromorphs. Maybe.

Here's what really happened. The zookeeper who was supposed to visit your class got sick. The zoo sent over the person who normally takes care of birds. The zookeeper who came to your class knew a lot about birds, but not much about fish.

His first stop that morning was at the mammal house to pick up the mon-goose. Then he went to the reptile house to get the iguana and the snake. He took all three animals with him into the fish house.

It was dark in the fish house. All the fish were arranged alphabetically in separate aquariums. The guppies were in the aquarium next to the gastromorphs. The zookeeper picked up a net, walked over to the gastromorphs, and leaned over the aquarium to dip some out. Just then the snake began to crawl out of its bag, so the zookeeper reached down to push it back in. When he stood up straight again he had three fish in his net. He dumped them into the fishbowl and hurried to your school. What he didn't know was that he had accidentally dipped the net into the wrong tank. He had netted three guppies instead of three gastromorphs.

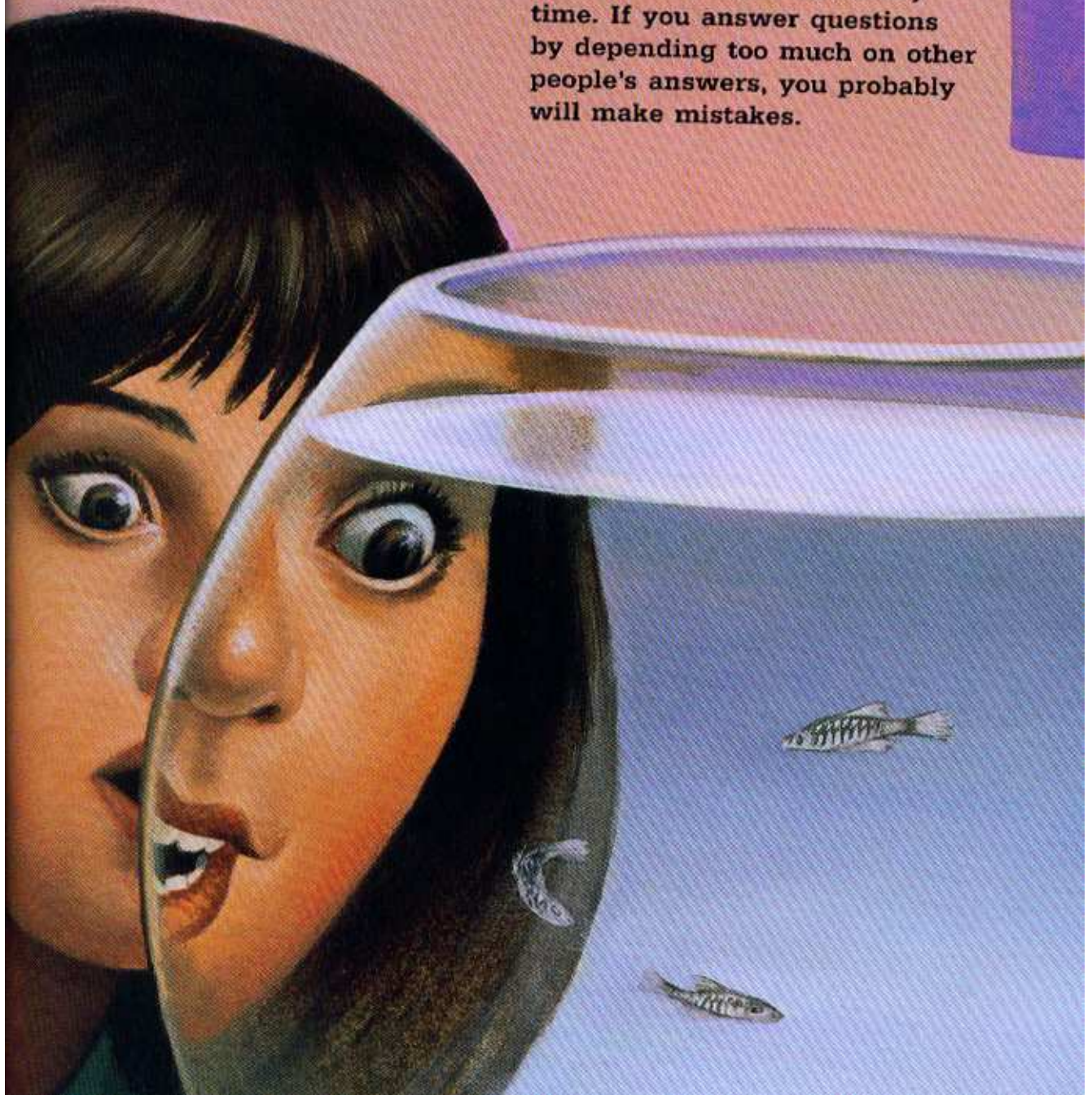
GASTRO



MORPHS?

You really were right! The fish were guppies, but you changed your mind because of what the zookeeper said.

Sometimes other people are wrong. Usually zookeepers know much more about animals than you do, but maybe not every time. If you answer questions by depending too much on other people's answers, you probably will make mistakes.



Because We Want To
Sometimes we know how we would like a question to be answered. We choose an answer to a question because it's the answer we like. Let's look at another story.

It's Friday afternoon, and the last bell of the day has just rung. You gather up your books and start toward the door of your classroom. As you step into the hallway your teacher calls out, "Don't forget to finish your math assignment. It's due Monday morning." You look down and check to be sure you have your math book.

The weekend passes quickly. On Friday night you go to a basketball game. On Saturday your family goes to the beach. Finally, on Sunday evening you clear a spot on the kitchen table and start to work on your assignment.

Just then the telephone rings. You hurry to answer it.

"Hi," says Pat. "What are you doing?"

"Math," you answer.

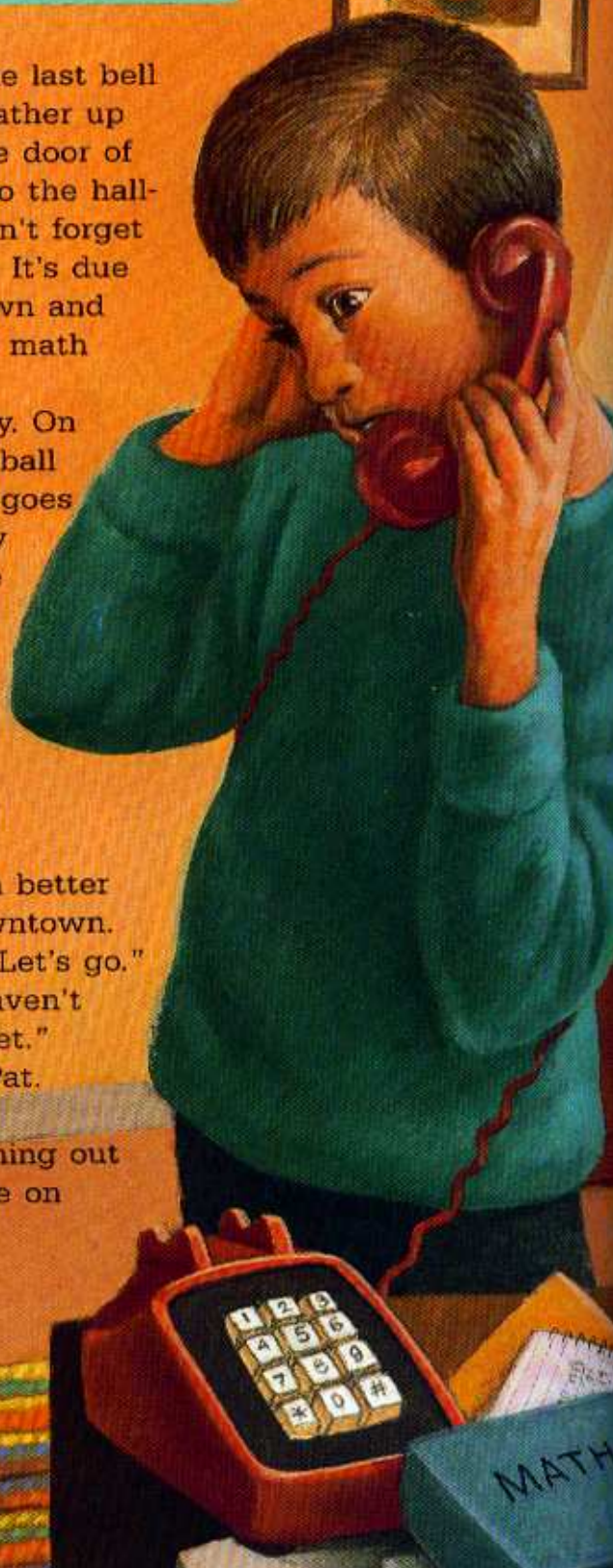
"Hey," says Pat, "I've got a better idea. There's a good movie downtown. My dad gave me some money. Let's go."

"I can't," you answer. "I haven't even started this assignment yet."

"It's a great movie," says Pat.

"Everyone says so."

"Look, report cards are coming out next week. I need a good grade on this paper."





WATCH
OUT!!!

"It's the last chance," says Pat. "They're changing movies tomorrow."

"Well . . ." You're having a terrible time deciding what to do. Then you suddenly remember something!

"Maybe we won't have to turn in this paper tomorrow. We haven't even graded Thursday's paper yet."

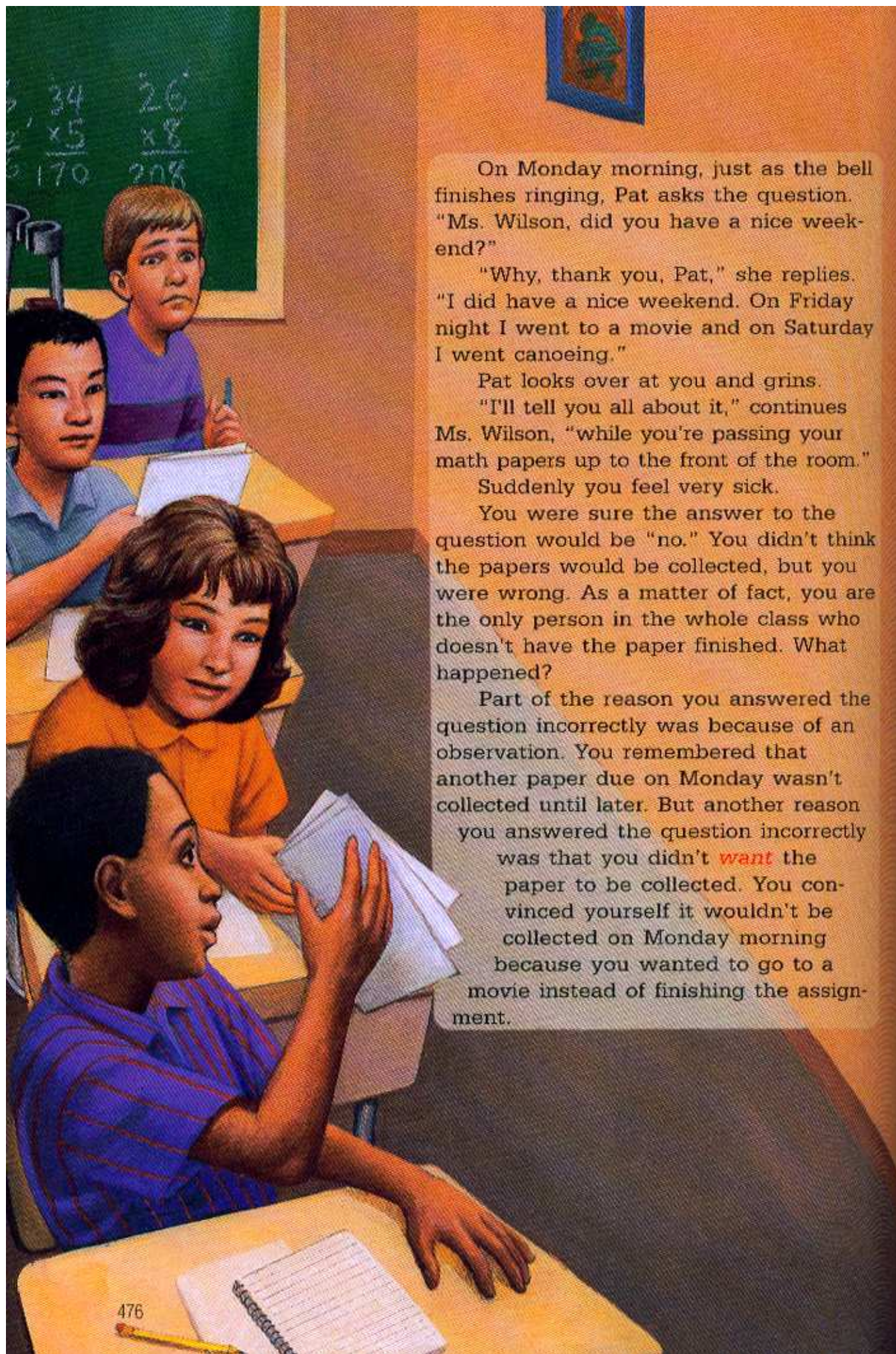
"That's right," says Pat.

You take a deep breath. All you can think about is how much you want to see the movie. "And Ms. Wilson does forget to collect papers sometimes. Remember last Monday's assignment? It was Wednesday before she collected it."

"Right!" says Pat. "I'll tell you what," he continues. "As soon as the bell rings on Monday, I'll ask her what she did this weekend. She'll forget all about the assignment."

"OK," you answer. "I'll be right over."

QUESTION: Is Ms. Wilson going to collect the math assignment Monday morning?



On Monday morning, just as the bell finishes ringing, Pat asks the question. "Ms. Wilson, did you have a nice weekend?"

"Why, thank you, Pat," she replies. "I did have a nice weekend. On Friday night I went to a movie and on Saturday I went canoeing."

Pat looks over at you and grins.

"I'll tell you all about it," continues Ms. Wilson, "while you're passing your math papers up to the front of the room."

Suddenly you feel very sick.

You were sure the answer to the question would be "no." You didn't think the papers would be collected, but you were wrong. As a matter of fact, you are the only person in the whole class who doesn't have the paper finished. What happened?

Part of the reason you answered the question incorrectly was because of an observation. You remembered that another paper due on Monday wasn't collected until later. But another reason you answered the question incorrectly was that you didn't *want* the paper to be collected. You convinced yourself it wouldn't be collected on Monday morning because you wanted to go to a movie instead of finishing the assignment.

Sometimes we really want the answer to a question to turn out in a certain way. Such a question can be difficult to answer correctly or fairly. Often it is easier to find an answer we like than an answer that is correct.

Carelessly used information, what others think, what we want to happen—none of these are very reliable ways of answering questions. Too many times they lead to wrong answers. Is there a better way? How can you find out whether throwing a dead snake over a tree branch really will bring rain?

There *is* a better way to find answers. Scientists use a series of steps called *the scientific method* to find accurate and reliable answers to their questions.

Good scientists are skeptical, but they keep an open mind. They know that experiments sometimes show that the correct answer to a question is not *always* the one you think it will be!

MEET STEPHEN P. KRAMER

Science has always fascinated Stephen P. Kramer. In college, he studied biology, the science of living things. After graduation, he taught science for four years on a Navajo reservation. Today, Kramer lives in Vancouver, Washington, where he writes and helps care for his two sons. His books combine his training as a biologist and his experience as a teacher. His first book, *Getting Oxygen: What Do You Do If You're Cell Twenty-Two?*, explains how the body gets and uses oxygen. *How to Think Like a Scientist* describes the scientific method, the step-by-step process that scientists use to learn about our world.

